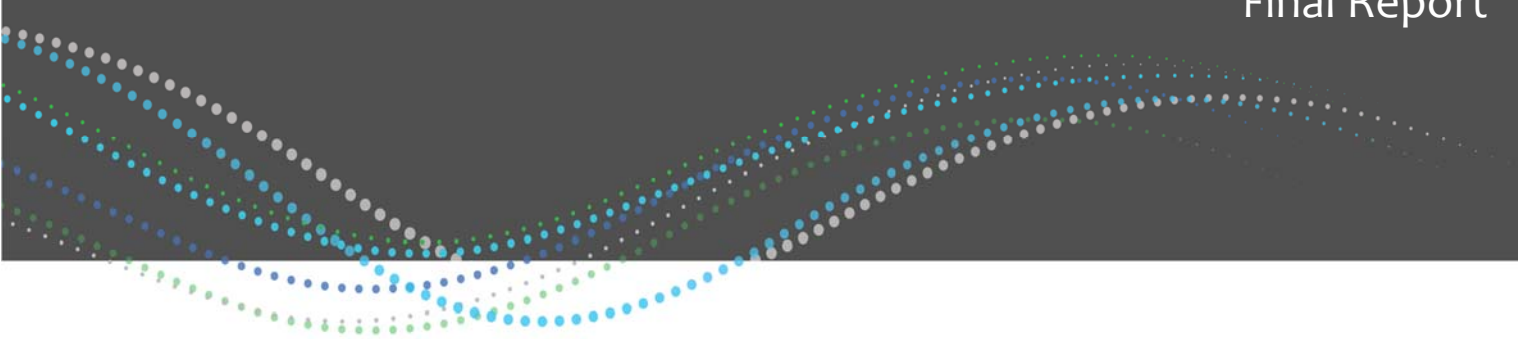


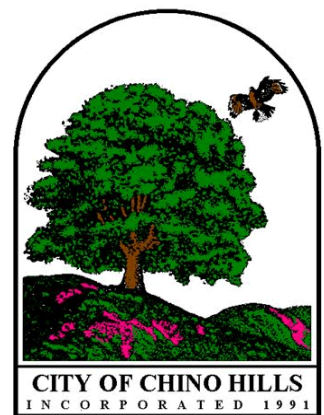


Carbon Canyon Road (SR-142) Phase II Corridor Study Final Report



December 12, 2018

Submitted to:



05321 | Prepared by Iteris, Inc.



TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
1.0 Introduction.....	5
2.0 Literature Review	7
3.0 Existing Conditions	8
3.1 Existing Traffic Volumes	8
3.2 Traffic Analysis Methodology	8
3.3 Existing Traffic Operations Analysis	9
3.4 Speed Evaluation	11
4.0 Collision Information	12
5.0 Future Traffic Forecasts	14
6.0 Key Issues	14
7.0 Truck Restriction.....	15
7.1 Truck Turning Template	22
8.0 Recommended Improvements.....	24
8.1 Congestion Reduction Improvements.....	24
8.2 Traffic Signals.....	26
8.3 Left-turn Refuge Lanes	29
8.4 Traffic Calming or Safety Measures.....	30
8.5 Pedestrian and Bicycle Mobility Improvements.....	37
8.6 Additional Considerations	40
8.7 Improvement Costs	41
9.0 Next Steps.....	43
APPENDIX A – Traffic Count Data.....	44
APPENDIX B – Intersection LOS Calculation Sheets	45
APPENDIX C – Signal Warrant Sheets.....	46
APPENDIX D – Typical Section Layout Sheets	47



TABLES

Table 1 – Intersection Level of Service Definitions – HCM Methodology.....	9
Table 2 – Existing Conditions Peak Hour Intersection LOS	10
Table 3 – Existing Roadway Volumes and Capacity	11
Table 4 – Improvement Measures Cost Estimates	42

FIGURES

Figure 1 – Project Study Area.....	6
Figure 2 - Carbon Canyon Road Collision Data.....	13
Figure 3 – Switchback Video Locations	15
Figure 4 – Observed Heavy Vehicle Turning Maneuvers	16
Figure 5 – S-Curve AutoTURN Template	23
Figure 6 – Free Right-turn Conceptual Plan	25
Figure 7 – Sight Distance Viewpoint along Azurite Drive.....	27
Figure 8 – Flashing Advance Warning Sign	28
Figure 9 – Left-turn Refuge at Carriage Hills Lane	29
Figure 10 – Left-turn Refuge at Valley Springs Road.....	30
Figure 11 – Sample Channelizer Island	31
Figure 12 – Channelizer Island west of Old Carbon Canyon Road	32
Figure 13 – Channelizer Island east of Carriage Hills Lane.....	33
Figure 14 – Channelizer Island east of Canon Lane.....	34
Figure 15 – Channelizer Island east of Discover Center Driveway.....	35
Figure 16 – Sample Speed Feedback Sign	36
Figure 17 – Potential Speed Feedback Sign Locations	36
Figure 18 – Typical Section Locations	39
Figure 19 – Bus Stop Improvement Locations	41



EXECUTIVE SUMMARY

This study evaluates Carbon Canyon Road (SR-142) within the Cities of Chino Hills and Brea, for the purpose of identifying improvement measures, which address key safety and mobility issues. The project segment is approximately 8.4 miles long, and extends from Chino Hills Parkway in Chino Hills on the north to Valencia Avenue in Brea on the south.

Based on analysis of available data and feedback from the community, it is understood that the key issues along the corridor include the following:

- Truck movements, with particular attention to S-curves (switchbacks);
- Perception of excessive speed;
- Heavy delays on minor streets turning onto Carbon Canyon Road;
- Line of sight visibility from minor streets turning onto Carbon Canyon Road; and
- Pedestrian and bicycle safety.

A toolkit of recommended measures or considerations for improved safety and mobility through the corridor are provided, which include: truck restrictions, traffic signals, placement of speed feedback signs, left-turn refuge lanes, and pedestrian/bicycle infrastructure improvements. The measures range from simple, low cost measures to long-range measures that require significant design and construction costs in order to implement. A summary of the key measures for consideration are as follows:

- Truck Restriction
 - Iteris will initiate the process to update SR-142 from a posted advisory route (Tractor-Semis over 30 feet kingpin to rear axle not advised) to a restricted route where vehicles over 30 feet kingpin to rear axle are prohibited. The restriction of heavy trucks on Carbon Canyon Road would not shift a significant amount of truck traffic to the regional state highway system, as truck traffic constitutes only approximately 1% of total vehicles on the corridor.
- Short-Term Measures
 - Installation of new traffic signals at Canyon Hills Road and Azurite Drive;
 - Installation of left-turn refuge/acceleration lanes at Carriage Hills Lane and Valley Springs Road;
 - Installation of channelizer “islands” near Old Carbon Canyon Road, Carriage Hills Lane, Canon Lane, and Discovery Center Driveway;
 - Installation of speed feedback signs near Canon Lane, Olinda Drive, and Discovery Center Driveway (to enhance drivers’ awareness of posted speed limit and encourage compliance with the law); and
 - Consideration of rumble strips in the eastbound direction west of the Discovery Center Driveway (Postmile 2.4).
- Long-Range Measures
 - Widening from one lane to two lanes in the southbound direction at the current lane transition area south of Chino Hills Parkway;



- o Addition of a northbound free right-turn lane at the Carbon Canyon Road/Chino Hills Parkway intersection;
- o Construction of pedestrian sidewalk with curb and gutter along the corridor; and
- o Construction of dedicated bicycle lanes along the corridor.

Upon completion of City review and approval, this report will be shared with Caltrans and the City of Brea. After that review process is complete, Iteris, in conjunction with the City of Chino Hills, will facilitate discussion with Caltrans on priority improvements in the corridor, including the recommended truck restriction. Funding for these improvements may be facilitated through Caltrans' State Highway Operation and Protection Program (SHOPP).

The SHOPP is California's "fix-it-first" program that funds the repair and preservation, emergency repairs, safety improvements, and some highway operational improvements on the state highway system. SHOPP funds are limited to capital improvements that do not add capacity (no new highway lanes). The majority of transportation improvements identified in this report fall within the Transportation Management Systems (TMS) core asset class within the program. Other funding program options are Measure I or other State funding programs through the Regional Transportation Improvement Program, both administered through the San Bernardino County Transportation Authority (SBCTA).



1.0 INTRODUCTION

This study evaluates Carbon Canyon Road (SR-142) within the Cities of Chino Hills and Brea, for the purpose of identifying improvement measures to address key safety and mobility issues. The project

segment, from Chino Hills Parkway on the north to Valencia Avenue on the south, is approximately 8.4 miles long. The segment within Chino Hills is 3.8 miles long and the segment within Brea is 4.6 miles long. While the segment within Chino Hills is physically shorter, it includes 12 intersections whereas the Brea segment includes 8 intersections. The majority of the project segment is a two-lane undivided roadway, with the exception of the southern end in the City of Brea (between Brea Hills Avenue and Valencia Avenue). **Figure 1** shows the project study area which includes segments within both Chino Hills (San Bernardino County) and Brea (Orange County).







2.0 LITERATURE REVIEW

This section summarizes the review of relevant studies, data, policies, and requirements related to support of the restriction of large vehicles and development of improvement projects on Carbon Canyon Road (SR-142), as part of the Carbon Canyon Road Phase II Study. The effort included a review of the Initial Corridor Evaluation Study (Phase I) completed by KOA, as well as applicable City of Chino Hills, City of Brea, Orange County, San Bernardino County, Caltrans, and regional plans as they relate to SR-142.

The key findings from the literature review are:

- The Caltrans District 8 Transportation Concept Report recommends relinquishment of SR-142 to the City of Chino Hills.
- SR-142 is defined as a MAP-21 Principal Arterial in the National Highway System (NHS).
- There are sections of Carbon Canyon Road where current roadway geometry is below standard.
- The steep grades impact the ability of trucks to move through the corridor at speeds near posted speeds. Roadway switchbacks located near the highest part of the route provide a challenge to truck movements and other vehicle movements. Slow truck movements also impact other vehicle movements.
- The current City of Chino Hills General Plan Circulation Element includes the following policies:
 - Continue to assert that all improvements to and maintenance of the portion of Chino Hills Parkway/Carbon Canyon Road that is part of SR-142 shall be the responsibility of the State of California; and
 - Retain the switchbacks on Carbon Canyon Road between Feldspar Drive and the Western Hills Country Club.
- Section 35701 of the California Vehicle Code allows restriction of vehicles by stating that, "(a) Any city, or county for a residence district, may, by ordinance, prohibit the use of a street by any commercial vehicle or by any vehicle exceeding a maximum gross weight limit...(b) The ordinance shall not be effective until...signs are erected...(c) No ordinance...shall apply to any state highway...in the National System of Interstate and Defense Highways, except (that) approved by a two-thirds vote of the California Transportation Commission."
- Caltrans has a recommended truck restriction process in accordance with the following CVC Sections: 21101(c) to prohibit "certain vehicles" on local routes and 21104 to prohibit "certain vehicles" on State routes; 35701 to prohibit vehicles by weight on local routes, and 35702 to prohibit vehicles by weight on State routes.
- The truck restriction process includes eight steps:
 1. Local Agency prepares a Draft Truck Restriction Ordinance or Resolution
 2. Local Agency prepares Initial Study
 3. Local Agency provides public review and comment period
 4. Local Agency receives comments and prepares Final Truck Restriction Report
 5. Caltrans Traffic Operations submits recommendation to the Director's Office
 6. Caltrans Director issues written approval
 7. Local Agency passes Final Truck Restriction Ordinance or Resolution
 8. Local Agency or Caltrans erects restriction signs, and restriction is enforced



3.0 EXISTING CONDITIONS

This section presents the existing traffic operations along the corridor. For the purpose of level of service (LOS) analysis, the project study area includes ten (10) intersections within Chino Hills and Brea, representing locations of specific concern (including all signalized locations). In addition, current roadway segment volumes and capacities are presented.

3.1 Existing Traffic Volumes

Traffic volumes were collected on May 24, 2018, on a typical weekday with local schools in session during the a.m. peak period (7:00 – 9:00 a.m.) and p.m. peak period (4:00 – 6:00 p.m.). In addition, 24-hour volume data was collected along the corridor, which included truck classification counts (large 2-axle, 3-axle, 4+-axle). Existing volumes provide a baseline to evaluate current performance of the circulation system and are used as the basis of future forecast volumes.

The following summarizes the results of the data collection:

- The Average Daily Traffic (ADT) volume through the corridor is approximately 15,700 in the vicinity of the Canyon Hills Road intersection (nearly mid-point of corridor).
- During the a.m. peak hour, the peak direction of traffic is west/southbound. The highest hourly west/southbound volume is 1,333 vehicles.
- During the p.m. peak hour, the peak direction of traffic is east/northbound. The highest hourly east/northbound volume is 1,254 vehicles.
- During the 24-hour period, approximately 1.3% of vehicles counted were trucks, the majority of which were large 2-axle trucks.

Existing traffic count data is provided in **Appendix A**.

3.2 Traffic Analysis Methodology

Intersections are typically considered to represent the most critical locations for traffic flow bottlenecks and general congestion on roadways. Conflicting traffic movements are created at intersections since the right-of-way (ROW) must be shared by opposing traffic streams. In this study, intersection LOS is measured to determine the peak hour operating conditions at the study intersections.

Analysis of traffic operations are conducted using the Synchro software, utilizing the Highway Capacity Manual (HCM) delay methodology, which is described in the Highway Capacity Manual, Special Report 209 (Transportation Research Board, Washington, D.C., 2000). Under the HCM methodology, LOS at signalized intersections is based on the average delay experienced by vehicles traveling through an intersection. The analysis incorporates the effects of the lane geometry and signal phasing (e.g. protected or permitted left turns) at signalized intersections. At unsignalized (or stop-controlled) intersections, vehicle delay of the worst-case stop-controlled movement is used to dictate the LOS grade. **Table 1**



presents a brief description of each level of service letter grade, as well as the range of delays associated with each grade for signalized and unsignalized intersections.

Table 1 – Intersection Level of Service Definitions – HCM Methodology

Level of Service	Description	Signalized Intersection Delay (seconds per vehicle)	Unsignalized Intersection Delay (seconds per vehicle)
A	Excellent operation. All approaches to the intersection appear quite open, turning movements are easily made, and nearly all drivers find freedom of operation.	≤ 10	≤ 10
B	Very good operation. Many drivers begin to feel somewhat restricted within platoons of vehicles. This represents stable flow. An approach to an intersection may occasionally be fully utilized and traffic queues start to form.	>10 and ≤ 20	>10 and ≤ 15
C	Good operation. Occasionally drivers may have to wait more than 60 seconds, and back-ups may develop behind turning vehicles. Most drivers feel somewhat restricted.	>20 and ≤ 35	>15 and ≤ 25
D	Fair operation. Vehicles are sometimes required to wait more than 60 seconds during short peaks. There are no long-standing traffic queues.	>35 and ≤ 55	>25 and ≤ 35
E	Poor operation. Some long-standing vehicular queues develop on critical approaches to intersections. Delays may be up to several minutes.	>55 and ≤ 80	>35 and ≤ 50
F	Forced flow. Represents jammed conditions. Backups from locations downstream or on the cross street may restrict or prevent movement of vehicles out of the intersection approach lanes; therefore, volumes carried are not predictable. Potential for stop and go type traffic flow.	> 80	> 50

Source: Highway Capacity Manual 2000, Transportation Research Board, Washington, D.C., 2000. Note that HCM 2000 is the most commonly used version of the HCM by most jurisdictions, though a more recent version is available.

3.3 Existing Traffic Operations Analysis

The existing a.m. and p.m. peak hour intersection traffic volumes are provided in **Appendix A. Table 2** summarizes the existing LOS results at the study intersections. Detailed intersection LOS calculation sheets are provided in **Appendix B**. There are currently 20 intersections along the corridor, the majority of which are unsignalized with relatively low levels of traffic volumes entering and exiting. This analysis includes the ten (10) key locations along the corridor that represent locations of specific concern (including all signalized locations).



Table 2 – Existing Conditions Peak Hour Intersection LOS

	Intersection	Jurisdiction	Traffic Control Type	AM Peak Hour		PM Peak Hour	
				Delay (s)	LOS	Delay (s)	LOS
1	Carbon Cyn Rd/Chino Hills Pkwy	Chino Hills	Signalized	31.3	C	31.3	C
2	Carbon Cyn Rd/Azurite Dr	Chino Hills	Stop-controlled	26.5	D	14.7	B
3	Carbon Cyn Rd/Canon Ln	Chino Hills	Stop-controlled	53.8	F	41.2	E
4	Carbon Cyn Rd/Canyon Hills Rd	Chino Hills	Stop-controlled	51.4	F	28.2	D
5	Carbon Cyn Rd/Rosemary Ln	Chino Hills	Stop-controlled	36.6	E	25.3	D
6	Carbon Cyn Rd/Olinda Pl	Brea	Signalized	70.6	E	4.5	A
7	Carbon Cyn Rd/Ruby St	Brea	Signalized	15.2	B	36.8	D
8	Carbon Cyn Rd/Brea Hills Ave	Brea	Stop-controlled	29.3	D	12.1	B
9	Carbon Cyn Rd/Santa Fe Rd	Brea	Signalized	20.4	C	26.7	C
10	Carbon Cyn Rd/Valencia Ave	Brea	Signalized	60.4	E	39.4	D

Notes: HCM 2000 Operations Methodology. LOS = Level of Service, Delay = Average Vehicle Delay (Seconds)
Delay shown at stop-controlled intersections reflects delay at worst-case stop-controlled approach

As shown in **Table 2**, the stop-controlled approaches at the Canon Lane, Canyon Hills Road, and Rosemary Lane intersections are currently operating at a deficient level of service (LOS E or worse). However, when considering all vehicles traveling through these intersections, the average vehicle delay is minimal, as a result of Carbon Canyon Road operating at free-flow conditions (no vehicle delay).

Within the City of Brea, the signalized intersections at Olinda Place and at Valencia Avenue are currently operating at LOS E during the a.m. peak hour, as a result of the large westbound traffic flow.

In addition to peak hour volumes, the daily volumes along the corridor were evaluated in comparison to theoretical roadway capacities, in order to identify deficiencies in the roadway network. In this analysis, a segment was considered deficient having a volume-to-capacity ratio of 1.00 or greater, and is considered near capacity with a volume-to-capacity ratio above 0.90. **Table 3** summarizes the daily volumes along with the planning-level capacity of the roadway. For two-lane undivided roadways, the theoretical capacity is assumed as 13,000 vehicles per day, while the four-lane divided roadway capacity is assumed as 30,000 vehicles per day.



Table 3 – Existing Roadway Volumes and Capacity

Carbon Canyon Road Location	Lane Configuration	Planning-level Capacity (veh/day)	Daily Volume	V/C
Carbon Cyn south of Chino Hills Pkwy	2-lane undivided	13,000	16,800	1.29
Carbon Cyn north of Canon Ln	2-lane undivided	13,000	14,000	1.08
Carbon Cyn north of Canyon Hills	2-lane undivided	13,000	15,670	1.21
Carbon Cyn north of Rosemary Ln	2-lane undivided	13,000	12,100	0.93
Carbon Cyn east of Olinda Pl	2-lane undivided	13,000	11,800	0.91
Carbon Cyn east of Ruby St	2-lane undivided	13,000	11,900	0.92
Carbon Cyn east of Brea Hills Ave	2-lane undivided	13,000	12,300	0.95
Carbon Cyn east of Santa Fe Rd	4-lane divided	30,000	12,500	0.42
Carbon Cyn east of Valencia Ave	4-lane divided	30,000	14,900	0.50

Notes: V/C = Volume-to-Capacity ratio

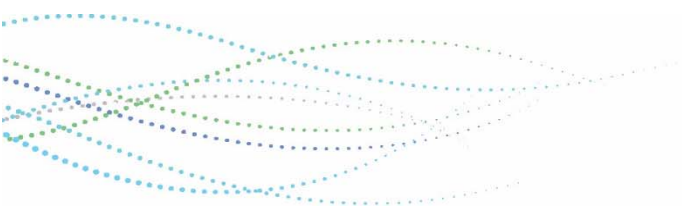
As shown in **Table 3**, the majority of Carbon Canyon Road segments (Chino Hills and Brea) have daily volumes that either exceed or are near the theoretical capacity for a roadway of that configuration (two-lane undivided).

3.4 Speed Evaluation

Speed limits vary along the Carbon Canyon Road corridor. From the northeast section (at Chino Hills Parkway) to Canyon Hills Road, the posted speed limit is 45 miles per hour. South of Canyon Hills Road, through the Sleepy Hollow neighborhood to the City/County limit, the posted speed limit is 35 miles per hour. Within this section, the roadway right-of-way narrows and the road curves, which contributes to lower travel speeds. Within the City of Brea, the posted speed limit reverts back to 45 miles per hour.

Average speeds along the corridor were reviewed using the Iteris iPeMS platform, developed for San Bernardino County. Using the database, average corridor speeds over a three-month period (June to August 2018) were extrapolated during multiple days and time periods. The following summarizes the current speed data:

- Weekday Conditions
 - A.M. Peak Period
 - 36 miles per hour average speed along southwest Carbon Canyon Road
 - 40 miles per hour average speed along northeast Carbon Canyon Road
 - P.M. Peak Period
 - 41 miles per hour average speed along southwest Carbon Canyon Road
 - 23 miles per hour average speed along northeast Carbon Canyon Road
 - Mid-day Period
 - 40 miles per hour average speed in both directions





- Weekend Conditions
 - Mid-day Period
 - 41 miles per hour average speed in both directions

During the weekday conditions, the varied speeds reflect the traffic volume patterns described in Section 3.1. The heavy a.m. peak hour flow of traffic is in the southwest direction, while the heavy p.m. peak hour traffic flow is in the northeast direction. As a result, average speeds are lower during those time periods. Average speeds during the mid-day period are approximately equal in each direction. Similarly, during weekend conditions, where there are not defined peak hours of traffic, speeds are generally equal in both directions during the day.

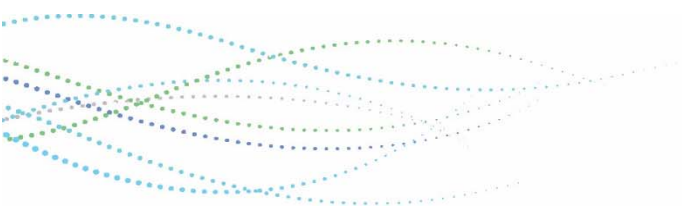
Based on the data collected, average speeds along the corridor are within the posted speed limit of 45 miles per hour through the majority of the corridor. However, within the Sleepy Hollow neighborhood, these average speeds exceed the posted speed limit of 35 miles per hour. In general, Caltrans sets speed limits based upon the 85th percentile speeds. Through community feedback, it is understood that vehicle speeds have been observed to exceed the average and 85th percentile speeds at some points of the day, but these instances represent the top 15% of speeds observed.

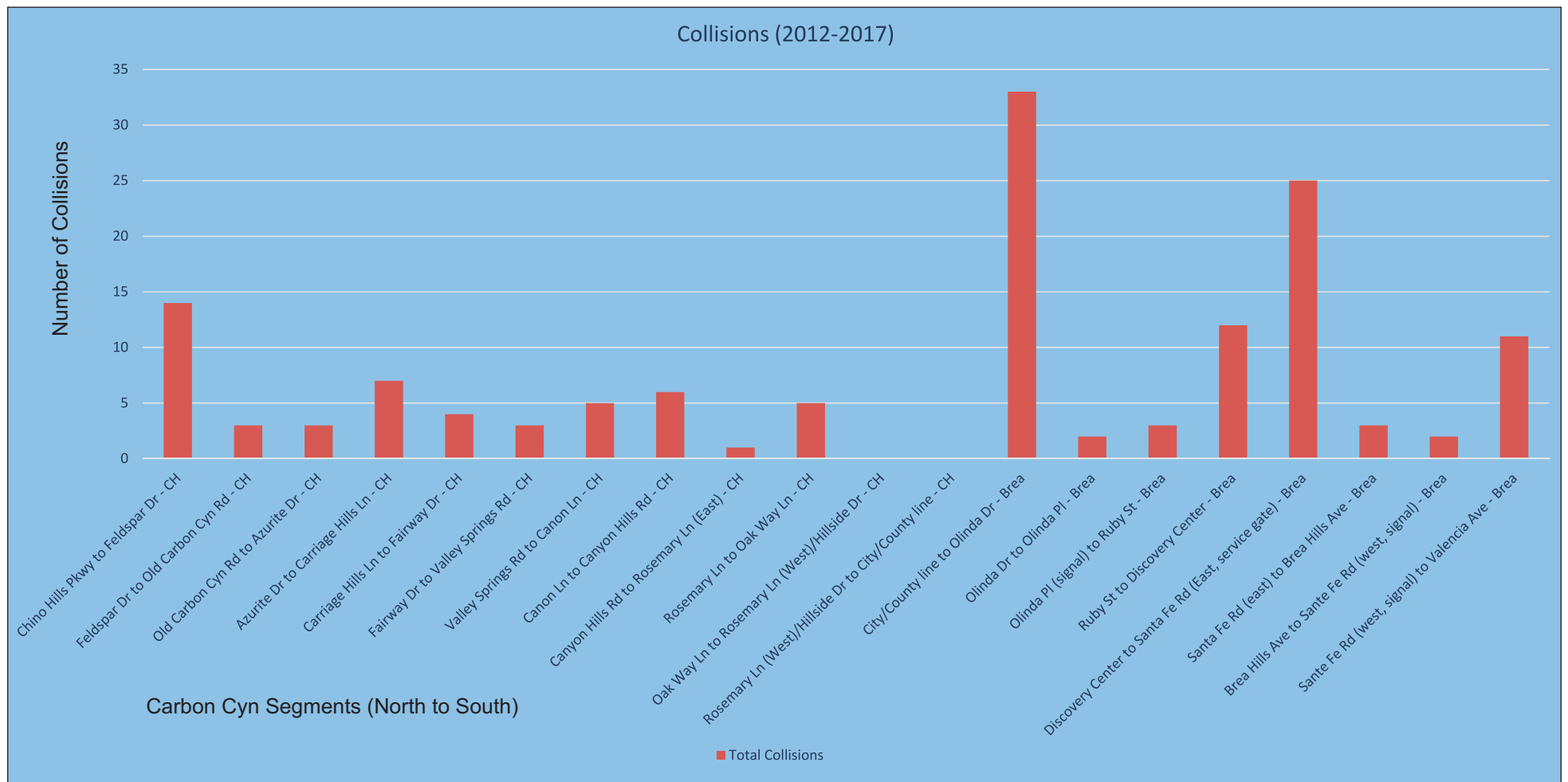
4.0 COLLISION INFORMATION

Collision data along Carbon Canyon Road was obtained for both the City of Chino Hills and City of Brea segments, over a 5-year period from 2012 to 2017. **Figure 2** shows the total collisions per segment, from north (left side of chart) to south (right side of chart). A total of 142 collisions were recorded during this period along Carbon Canyon Road.

As shown, the highest occurrences of collisions over the period occur from the City/County line to Olinda Drive and from the Discovery Center to Santa Fe Road (east). Both of these segments are within the City of Brea. The City/County line to Olinda Drive segment is the longest segment in the study corridor (1.83 miles), thus it is not unusual that higher collisions would occur in comparison to the shorter segments.

Of the 142 collisions, two collisions involved bicyclists, five collisions involved pedestrians, and there were a total of 188 injuries. One of the pedestrian-related collisions resulted in a fatality, in the vicinity of the Canon Lane intersection. The most common types of collisions along the corridor were rear-end collisions, followed by hit objects and broadside collisions. Of the total collisions collected during that period, one collision involved a truck.







5.0 FUTURE TRAFFIC FORECASTS

The Southern California Association of Governments (SCAG) 2016 RTP/SCS model was used to evaluate long-range traffic growth along the corridor. This version of the model is considered to be the most up-to-date version at the time. The land use assumptions were taken directly from the SCAG 2016 RTP model, and are values that were developed by SCAG in coordination with and approval by each jurisdiction in the six-county region (using the most up-to-date information at the time). The SCAG model's base year scenario is 2012 and the future year scenario is 2040. Along Carbon Canyon Road, the projected growth in traffic volumes is approximately 10% to 15% between the base and future year scenarios. Along with this growth, truck traffic would increase accordingly, though is forecast to remain at approximately the same percentage of total volume as in existing conditions.

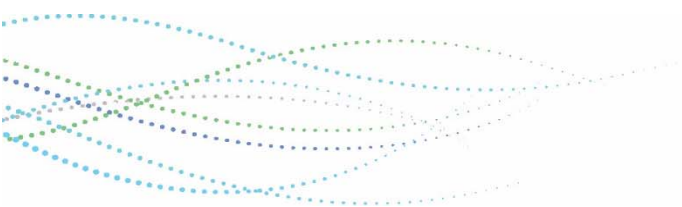
Traffic growth is also anticipated along freeways in the vicinity of Carbon Canyon Road, including SR-91, SR-57, and SR-71. During the most congested conditions, there is the potential that traffic utilizing these freeways would utilize Carbon Canyon Road instead.

In addition, it is understood that the City of Corona is currently evaluating the Trails of Corona project, a mixed-use development project comprising approximately 104.8 acres (425 single-family residences). When fully built out, this project has the potential to increase traffic volumes along SR-71 through Chino Hills, as well as the other freeways in the vicinity.

6.0 KEY ISSUES

The City of Chino Hills has sought feedback from community members on perceived issues relating to traffic and safety along the corridor. In addition to written comments provided by residents, Iteris and City staff received comments during a June 14, 2018 meeting in which Iteris presented preliminary findings and improvement opportunities. A summary of the identified issues brought forth by the community are as follows:

- Truck movements, with particular attention to S-curves (switchbacks);
- Perception of excessive speed;
- Heavy delays on minor streets turning onto Carbon Canyon Road;
- Line of sight visibility from minor streets turning onto Carbon Canyon Road; and
- Pedestrian and bicycle safety.





7.0 TRUCK RESTRICTION

Stakeholder outreach indicated truck and large vehicle usage of the roadway as a safety and operations concern. While the volume of trucks using Carbon Canyon Road is low (1.3% of total vehicles per day), their presence is amplified by the roadway's geometric conditions: change in elevation, tight curves, and a switchback section of roadway from Postmile (PM) 7.8 to 8.1.

Trucks take longer to accelerate on uphill grades, longer to stop on downhill grades, and must off-track to navigate narrow turns. Off-tracking means the front and rear wheels follow different paths when turning. Off-tracking results in trucks entering shoulder areas and the opposing traffic lanes. Since SR-142 is a two-lane facility, the encroachment of large vehicles on shoulder areas and opposing traffic lanes is a major safety and congestion concern. Improvement of the roadway to eliminate the geometric constraints for large vehicles on SR-142 would be a long-term project at high cost to address issues related to 1.3% of the vehicles traveling on the roadway.

Iteris collected 24-hour video camera footage of the Carbon Canyon Road segment within the switchback area. The videos were collected over a seven-day period from July 13 to July 20, 2018. The purpose of the video collection was to observe heavy truck maneuvers down the hill, specifically at the two sharp curves. Two cameras were utilized, placed at the locations shown in **Figure 3**.

During the course of the video collection, multiple occasions were observed where heavy trucks either slightly infringed or fully crossed over the roadway centerline. **Figure 4** shows video screenshots of a few of these recorded maneuvers. As shown in the sequence of screenshots, some trucks were observed crossing the centerline by approximately 4 to 5 feet at the beginning of their turn and up to approximately 12 feet at the end of their turn.

Figure 3 – Switchback Video Locations





Figure 4 – Observed Heavy Vehicle Turning Maneuvers





Carbon Canyon Road (SR-142)
Phase II Corridor Study
Final Report





Carbon Canyon Road (SR-142)
Phase II Corridor Study
Final Report





Carbon Canyon Road (SR-142)
Phase II Corridor Study
Final Report





Currently, trucks are not restricted on SR-142; however, it is a posted advisory route. At the southern Chino Hills City limit, currently there is a sign that reads “TRACTOR-SEMI OVER 30 FEET KINGPIN-TO-REAR AXLE NOT ADVISED”. At the northern end of the corridor, south of Chino Hills Parkway, currently there is a sign that reads “VEHICLE LENGTH OVER 50 FT NOT ADVISED BEYOND OLD CANYON RD”. Also, the same sign is located approximately 850 feet east of Old Carbon Canyon Road. Based on the video observations, analysis of the corridor, and limited options for altering road geometrics, it is recommended that the advisory be revised to prohibit vehicles that are over 30 feet kingpin-to-rear axle. Given the low usage of the corridor by heavy trucks, restricting trucks would likely have only a minor impact to commerce and traffic operations along alternate routes. In addition, the majority of truck volume occurs outside of the a.m. and p.m. peak hours. The two alternate routes to accommodate trucks from SR-142 would be SR-71 to SR-91 to SR-90 on the east and SR-71 to SR-60 to SR-57 on the west. These major freeway routes are reasonable alternatives to SR-142, which is currently not advised for large vehicles.

Caltrans sets transportation regulations relating to maximum truck size and weight. These regulations are to ensure that trucks have safe operating characteristics (fitting under bridges, adequate turning radius, stopping capability, etc.) and that trucks do not create undue damage to state highways and city streets. The California Vehicle Code (CVC) does allow local jurisdictions to issue permits to vehicles in excess of these size or weight standards. In order for the local jurisdiction to impose restrictions on a state highway, the restriction ordinance or resolution must be submitted to Caltrans for approval before enactment.

The following draft Truck Restriction Ordinances for the Chino Hills section and the Brea section of SR-142 were developed for submission, along with this study, to Caltrans, local agencies, and California Highway Patrol staff, as well as trucking industry stakeholders, affected industries, and citizen groups. Below is draft text for an ordinance for review by each City and stakeholder groups:

City of Chino Hills Draft Ordinance / City Council Resolution

Sec. X1. - Trucks with kingpin-to-rear axle distance (KPRA) over 30 feet are prohibited on State Highway 142 within the City of Chino Hills. The maximum KPRA shall be 30 feet of vehicle and load on State Highway Route 142 from Chino Hills Parkway to the Orange County Line (PM 5.75). State Highway Routes 57, 60, 71, 90, and 91 are hereby designated as alternate routes for the use of such vehicles that are prohibited from the use of Route 142.

Sec. X2. - Exceptions.

The following shall be excepted from the vehicular KPRA restriction imposed by Section X: Police and Fire Department vehicles, passenger buses, recreational vehicles, and utility vehicles which need to enter the area for the purpose of providing services, making pickups or deliveries of goods, wares and merchandise, or delivering construction materials to sites within the restricted highway segment and have no other means of access, while actually involved in and transacting such activities.



City of Brea Draft Ordinance / City Council Resolution

Sec. X1. - Trucks with kingpin-to-rear axle distance (KPRA) over 30 feet are prohibited on State Highway 142 within the City of Brea. The maximum KPRA shall be 30 feet of vehicle and load on State Highway Route 142 from Lambert Road (PM 1.8) to the San Bernardino County Line (PM 5.75). State Highway Routes 57, 60, 71, 90, and 91 are hereby designated as alternate routes for the use of such vehicles that are prohibited from the use of Route 142.

Sec. X2. - Exceptions.

The following shall be excepted from the vehicular KPRA restriction imposed by Section X: Police and Fire Department vehicles, passenger buses, recreational vehicles, and utility vehicles which need to enter the area for the purpose of providing services, making pickups or deliveries of goods, wares and merchandise, or delivering construction materials to sites within the restricted highway segment and have no other means of access, while actually involved in and transacting such activities.

If approved by Caltrans District 8 Office (for the City of Chino Hills portion) and District 12 Office (for the City of Brea Portion) and Caltrans Headquarters, the City of Chino Hills and City of Brea could adopt final truck restriction ordinances or resolutions. Caltrans would erect restriction signage and enforcement of the restriction would begin.

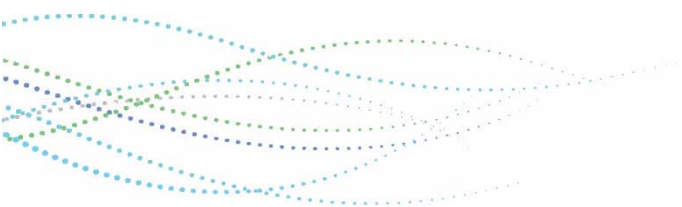


7.1 Truck Turning Template

A truck turning template was prepared in order to simulate the movement of heavy trucks at the two switchback curves. Utilizing the AutoTURN 8.1 software, Iteris modeled the swept path maneuvers for the truck movements along the curves. An intermediate semi-trailer (WB-40) was used as the design vehicle. All vehicle dimensions and swept paths are based on standards from AASHTO's *A Policy on Geometric Design of Highways and Streets*. **Figure 5** shows the truck turning template.

As shown, under an ideal turning maneuver, in order for a truck to avoid infringing on the centerline, it would need to infringe on the shoulder/dirt area along the inside of the curve. Based on the field observations, truck drivers chose to infringe across the centerline in the absence of opposing traffic. Under light traffic conditions, this is a reasonable accommodation in the limited roadway geometrics. However, during peak travel times this can present a safety hazard by forcing a large vehicle driver to choose from driving in the shoulder or across the roadway centerline and be a hazard to opposing traffic or to cyclists and pedestrians who may be utilizing the shoulder area.

A potential mitigation for this difficult turning maneuver would be for Caltrans to widen the roadway along the inside of the curve. Even if the inside shoulder were to be widened via additional pavement, though, heavy trucks would still likely have to make a tight turning movement on the steep grade. The effectiveness of this mitigation would require further study.







8.0 RECOMMENDED IMPROVEMENTS

This section presents a toolkit of recommended measures or considerations for improved safety and mobility through the corridor, in both Chino Hills and Brea. The measures range from simple, low cost measures to long-range measures that require significant costs in order to implement.

8.1 Congestion Reduction Improvements

As described in Section 3.3, based on the traffic volumes and lane configurations, the Carbon Canyon Road/Chino Hills Parkway intersection is currently shown to operate at LOS C during both peak hours, when using the Synchro software. This LOS represents the average vehicle delay for all vehicles approaching the intersection. However, it is recognized that during the a.m. peak hour, the heavy westbound left-turn demand may not be fully satisfied as Carbon Canyon Road transitions from two lanes to one southbound lane downstream from the intersection. This transition causes merging of vehicles that creates a queue back-up to Chino Hills Parkway. As a result of this back-up, it is estimated that not all westbound left-turn vehicles are able to make it through the signal within one cycle and may not have been fully counted during the data collection. An improvement to ease the congested condition would be to widen Carbon Canyon Road to two lanes for a 0.5 mile stretch in the southbound direction from the current two-lane to one-lane transition point.

In addition, to improve traffic operations during the p.m. peak hour in particular, a northbound free right-turn lane is recommended. During the p.m. peak hour, approximately 900 vehicles use this right-turn lane. The improvement would allow for right-turning traffic to bypass the traffic signal, thus reducing vehicle delay at the intersection. A conceptual plan of this recommendation is shown in **Figure 6**.

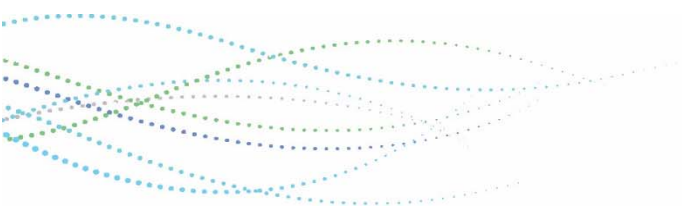




Figure 6 – Free Right-turn Conceptual Plan

At the Olinda Place/Carbon Canyon Road intersection in the City of Brea, in order to improve the deficient a.m. peak hour traffic operation, an additional westbound through lane would be required. In order for this improvement to function properly, widening would be required to add a westbound through lane at the downstream Ruby Street intersection, which would continue west of the intersection. These improvements are not considered feasible due to the immediate uphill slope north of Carbon Canyon Road.

The signalized Carbon Canyon Road/Valencia Avenue intersection in the City of Brea is also currently operating at a deficient LOS during the a.m. peak hour. This deficient operation is primarily caused by a heavy westbound left-turn volume of 862 vehicles. In order to improve the operation of the intersection, a third westbound left-turn lane would be required. However, this improvement would not be feasible without widening the south leg intersection departure to accommodate three lanes of traffic. Currently, southbound Valencia Avenue consists of two travel lanes and a bicycle lane in this section. The feasibility and cost effectiveness of this measure would require further study.

In addition, during the p.m. peak hour, it is understood that the Carbon Canyon Road/Valencia Avenue intersection experiences queuing in the northbound direction as a result of the heavy flow of vehicles (580 peak hour vehicles) onto eastbound Carbon Canyon Road. While there is currently a free northbound right-turn lane at the intersection, the northbound right-turning vehicles may not be able to fully access the right-turn pocket during peak traffic conditions. A potential improvement would be to extend the northbound right-turn pocket. At the intersection departure in the eastbound direction, the heavy flow of northbound right-turning traffic must merge with the eastbound Carbon Canyon Road through traffic.



Another consideration would be to extend this merge lane, longer than the current 300 feet, in order to relieve congestion at both the intersection and the roadway segment east of the intersection. Extending this eastbound merge lane would require re-striping the roadway to reduce either the length of the dual westbound left-turn lanes or the length of the number three westbound through lane (outside lane).

8.2 Traffic Signals

Currently, there are no signalized intersections along the Chino Hills portion of the corridor (with the exception of Chino Hills Parkway at the north end). Traffic along Carbon Canyon Road operates at free-flow conditions. Installation of traffic signals would provide for orderly movement of traffic at an intersection, protected turning movements, and would have the effect of reducing the delay of vehicles accessing the minor streets. Along with these benefits, the frequency of broadside collisions would be reduced. However, with the reduction in vehicle delay to minor streets, conversely an increase in delay to through traffic along Carbon Canyon Road would result.

A new traffic signal is currently proposed and is in the design phase (at the time of this report) at the Canyon Hills Road/Carbon Canyon Road intersection. The new signal is the result of anticipated increases in traffic along Canyon Hills Road from future development. Currently a T-intersection, a fourth leg is anticipated to be built on the east side of the intersection to provide access to a proposed residential development. Traffic volumes are projected to satisfy the Manual on Uniform Traffic Control Devices (MUTCD) minimum requirements for installation of a signal warrant.

A new traffic signal should also be considered at the Azurite Drive/Carbon Canyon Road intersection. Considering the sight-distance issues for vehicles turning onto Carbon Canyon Road off of Azurite Drive, a traffic signal at this location could provide safety benefits. As shown in **Figure 7**, the sight distance of vehicles along the Azurite Drive approach is limited, particularly when looking left (looking east).

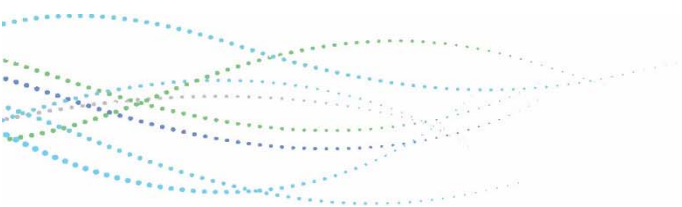




Figure 7 – Sight Distance Viewpoint along Azurite Drive



Looking right (west) along Carbon Canyon Rd



Looking left (east) along Carbon Canyon Rd



However, traffic volumes exiting the Summit Ranch neighborhood at Azurite Drive do not currently satisfy MUTCD minimum peak hour volume requirements. A total of 22 a.m. peak hour and 9 p.m. peak hour vehicles were counted during the May 2018 traffic count.

As a complement to any traffic signal, flashing advance warning signs should be provided in order to alert motorists that a signalized intersection is downstream. This treatment is especially suitable in locations where sight distance is limited and where the downstream signal is located on a downgrade. In addition to making the motorist aware of the upcoming signal, the advance warning sign may also provide information to the motorist about the operation of the traffic signal. This information will allow the motorist to make safer decisions ahead of time (i.e. preparing to stop). An example of a flashing advance warning sign is shown in **Figure 8**.



Figure 8 – Flashing Advance Warning Sign

In addition, based on the LOS/delay results, potential traffic signals at Canon Lane and Rosemary Lane were considered and assessed. Traffic volumes at minor street approaches at these two intersections are not high enough to satisfy the MUTCD peak hour warrant. The minor street volumes are as follows:

- Canon Lane – Highest approach volume is 30 vehicles at the eastbound approach during the a.m. peak hour; and
- Rosemary Lane – Highest approach volume is 5 vehicles at the southbound approach during the p.m. peak hour.

For these unsignalized intersections, MUTCD Signal Warrant evaluation sheets are included in **Appendix C**. A total of nine signal warrants are provided by MUTCD. Of the nine, the following warrants are used in this study:

- Warrant 1 – 8-hour vehicular volume;
- Warrant 2 – 4-hour vehicular volume;
- Warrant 3 – Peak hour volume; and
- Warrant 7 – Crash Experience.

All other warrants are either not applicable to these locations, or sufficient data is lacking in order to complete (such as pedestrian counts, though these are understood to be minimal). In **Appendix C**, the Warrant 2 and Warrant 3 graphs show the recommended thresholds for satisfying the warrant, as well as where the volumes at each intersection fall within the graph.



8.3 Left-turn Refuge Lanes

A left-turn refuge lane is an auxiliary lane that allows for left-turning vehicles off a minor street to accelerate along a major street (Carbon Canyon Road) before merging into the through lane. This improvement is intended to reduce vehicle delay from left-turning vehicles off the minor street as well as reduce sideswipe and rear-end collisions. It allows for the left turn to be completed in a two-step process.

This improvement is recommended at two T-intersections along the corridor, within the City of Chino Hills: Carriage Hills Lane and Valley Springs Drive. Conceptual plans of the recommended improvements are shown in **Figures 9** and **10**. Implementing this improvement would not present a new configuration to the corridor, as a similar feature is provided at the Feldspar Drive intersection in Chino Hills, as well as the Discovery Center Driveway and Santa Fe Road (east) intersections in Brea.

Figure 9 – Left-turn Refuge at Carriage Hills Lane

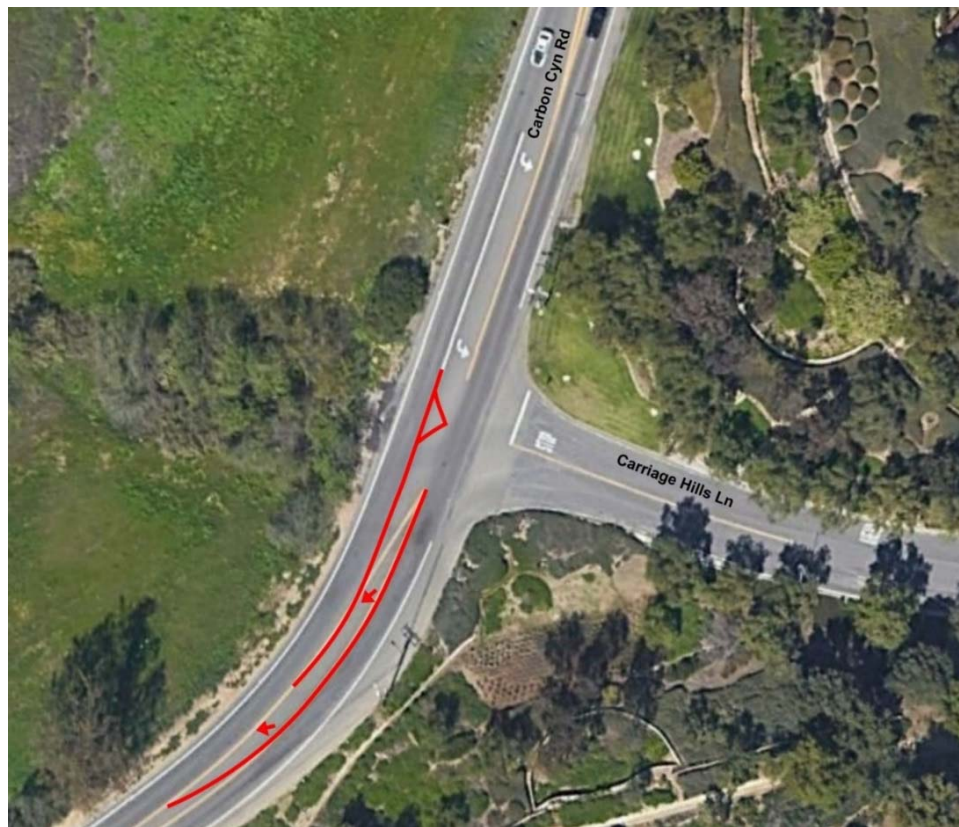




Figure 10 – Left-turn Refuge at Valley Springs Road



8.4 Traffic Calming or Safety Measures

This section describes countermeasures recommended for improved traffic calming and safety along the corridor.

8.4.1 Channelizers

Tubular channelizing markers or “channelizers” are recommended to create a center island that narrows the driver’s perception of the roadway. The treatment can have the effect of creating a sense of friction on the roadway. Typical channelizers may be between 18 and 36 inches tall, spaced 4 to 5 feet apart, and are yellow and/or orange in color. In addition, a speed limit sign placed on a mountable sign support could be located on either end of the island section where feasible, as shown in the following example in **Figure 11**.



Figure 11 – Sample Channelizer Island



This improvement is recommended at the following four locations along Carbon Canyon Road, where centerline striping currently includes an island: west of Old Carbon Canyon Road, east of Carriage Hills Lane, east of Canon Lane, and east of Discovery Center Driveway. Conceptual plans at the recommended improvement locations are shown in **Figures 12 through 15**.

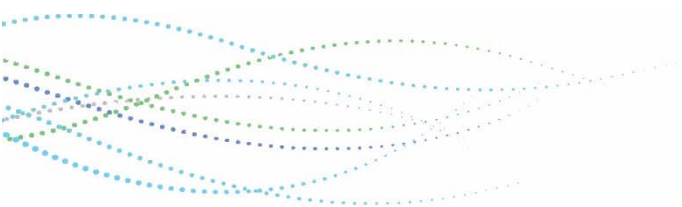




Figure 12 – Channelizer Island west of Old Carbon Canyon Road





Figure 13 – Channelizer Island east of Carriage Hills Lane





Figure 14 – Channelizer Island east of Canon Lane

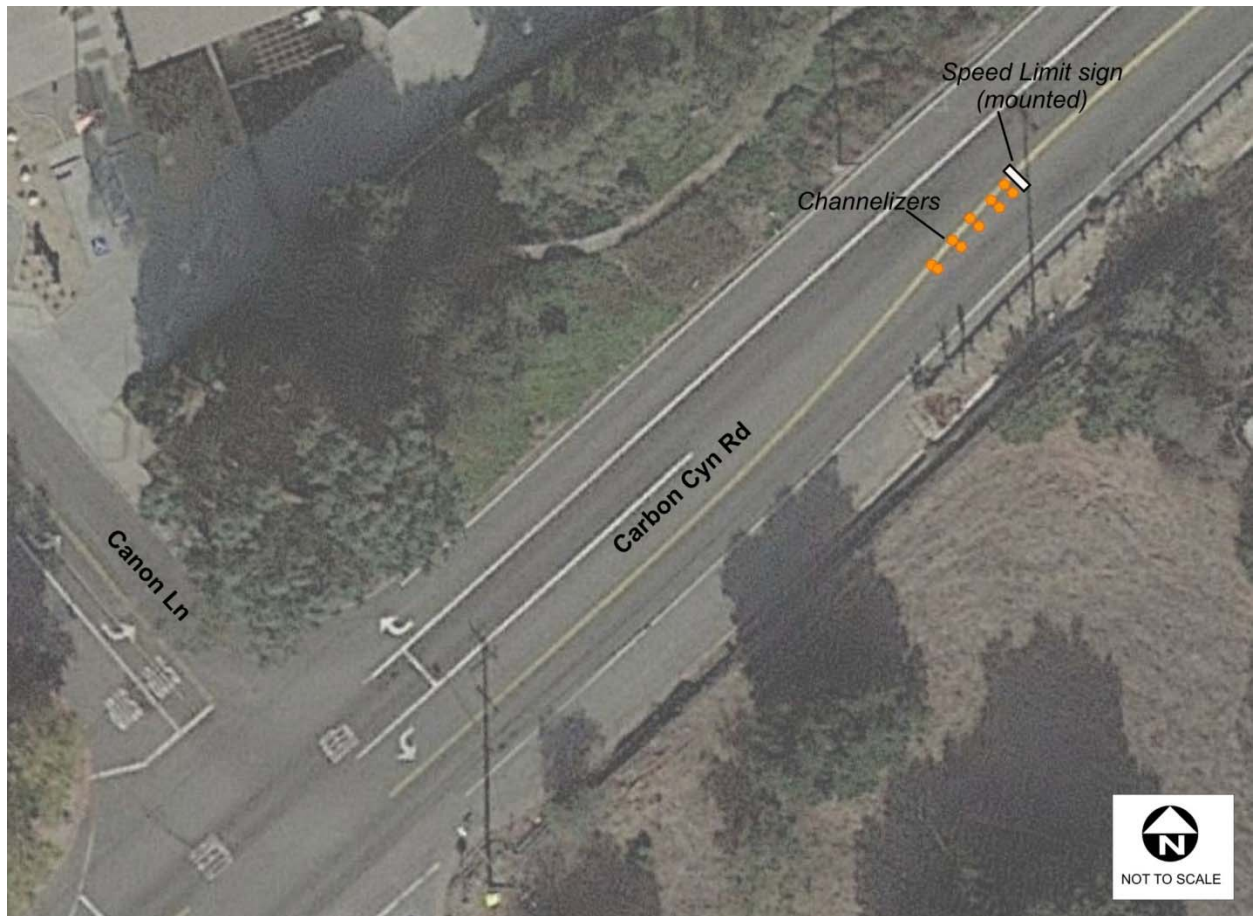




Figure 15 – Channelizer Island east of Discover Center Driveway



8.4.2 Speed Feedback Signs

The installation of speed feedback signs along roadways where vehicles typically travel at higher speeds can result in drivers slowing down, particularly in the immediate timespan following installation. Speed feedback signs can enhance drivers' awareness of the posted speed limit and encourage drivers to comply with the law. By displaying both the posted speed limit and their actual traveling speed, motorists are reminded how far above the speed limit they are traveling. There are various types of solar and/or battery-powered signs available. **Figure 16** shows an example of a speed feedback sign accompanied by the posted speed limit.

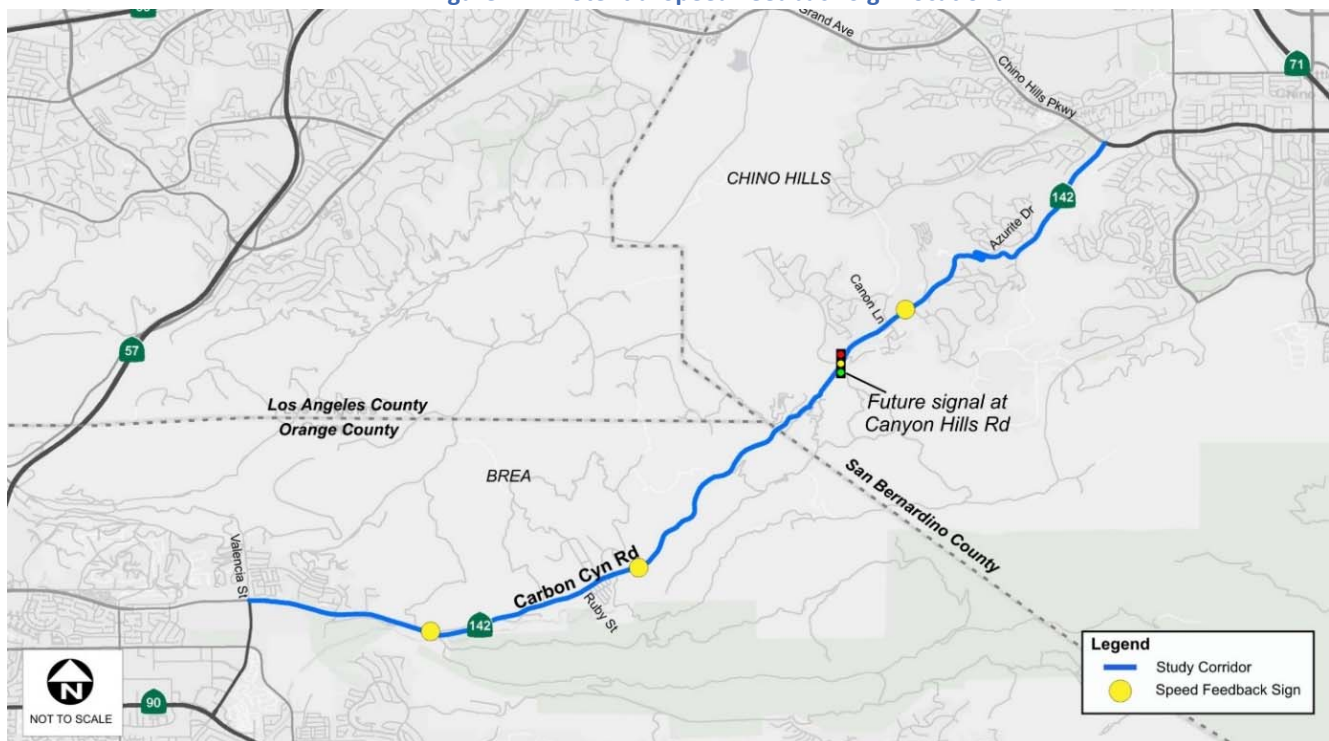


Figure 16 – Sample Speed Feedback Sign



Figure 17 shows the recommended locations for initial placement of speed feedback signs within the Cities of Chino Hills and Brea.

Figure 17 – Potential Speed Feedback Sign Locations





It should be noted that over time these devices can reduce in effectiveness, as motorists become desensitized to their presence. Thus, a regular program of relocation can help improve the effectiveness along the corridor.

8.4.3 Rumble Strips

Rumble strips are a safety/traffic calming measure that can be installed as a low cost countermeasure to reduce the frequency of single-vehicle run-off-road (SVROR) and cross-center line crashes. Rumble strips function as a means of alerting inattentive motorists whose vehicles have drifted out of their travel lane. A tactile vibration and audible rumbling is transmitted through the wheels into the vehicle interior upon driving over the strips.

Based on a review of collision data, this countermeasure, in conjunction with others, could be applicable along Carbon Canyon Road in the City of Brea, in the vicinity of the Discovery Center Driveway. A large majority of collisions in the eastbound direction at this location occurred in the afternoon peak period and involved a vehicle code violation of speeding.

8.5 Pedestrian and Bicycle Mobility Improvements

There are currently no sidewalks along Carbon Canyon Road, with limited curbs and gutters in a few locations. The *Institute of Transportation Engineers* (ITE) states that sidewalks “reduce the incidence of pedestrian collisions, injuries, and deaths in residential areas and along two-lane roadways.” The presence of curbs and sidewalks along a street provides pedestrians with a separation from motorized traffic, and thus a sense of security that encourages walking.

Marked bike lanes are currently provided on a short segment (0.2 miles) between Feldspar Drive and Old Carbon Canyon Road. Shoulder widths through the corridor vary, thus providing de-facto/unmarked bike lanes in some areas.

In order to improve the safety of pedestrian and bike mobility through the corridor, a consideration should be given for constructing dedicated infrastructure for each mode. Sidewalks should be at least five feet in width, bicycle lanes should be five to six feet in width, and each should have appropriate buffering. It is anticipated that costly utility relocation, tree removal, and ROW acquisition would be required in order to provide either a concrete sidewalk or dedicated bike lane in each direction through the corridor. For this reason, these are considered long-range improvements.

Another measure that is commonly used for traffic calming and improved pedestrian safety is a marked crosswalk (either mid-block or at an unsignalized intersection). When placed in proper locations, mid-block or unsignalized intersection crosswalks can provide manageable crossing points for pedestrians that may otherwise cross at random locations due to the large distance between signalized/controlled crosswalks. A High-Intensity Activated Crosswalk (HAWK) would be recommended to go along with the marked crosswalk. The HAWK is a pedestrian-activated hybrid beacon used to warn and control traffic at an unsignalized location to assist pedestrians crossing a highway. This measure may be considered at locations where traffic signal warrants are not met.



While Carbon Canyon Road could benefit from the traffic calming effects of adding a new crosswalk with a HAWK treatment, there is currently a lack of compatible land use origin-destination pairs along both sides of the corridor. An example of a compatible land use origin-destination pair is a neighborhood/community park across the street from a residential neighborhood. Based on the current and near-term land uses, there is little incentive for pedestrians to cross Carbon Canyon Road at mid-block locations or unsignalized intersection locations. As a result, a mid-block or unsignalized intersection crosswalk is considered a long-range improvement, to be further studied subject to the buildout of compatible land uses along the corridor. In addition, this treatment is generally not recommended along roadways with a posted speed limit greater than 40 miles per hour. For the majority of Carbon Canyon Road, the posted speed limit is 45 miles per hour.

8.5.1 Right-of-Way Analysis

Caltrans right-of-way widths along the Carbon Canyon Road corridor vary depending on the location. Utilizing layout plans prepared by Caltrans, ROW widths at five typical mid-block sections, spread out along the corridor, were evaluated in order to assess the amount of space that may be needed to accommodate either a dedicated bicycle lane, a pedestrian sidewalk, or both, while maintaining shoulders where possible. The locations of the five typical sections evaluated in this analysis are shown in **Figure 18**. The locations are shown in further detail on the detailed layout plans prepared by Caltrans, provided in **Appendix D**. They vary in ROW widths, shoulders, and grade.

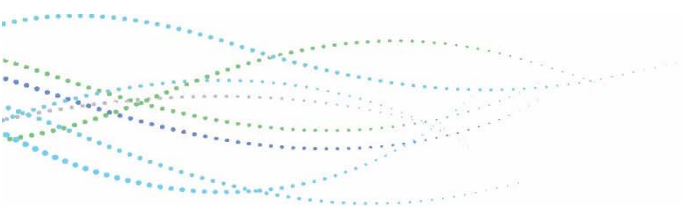
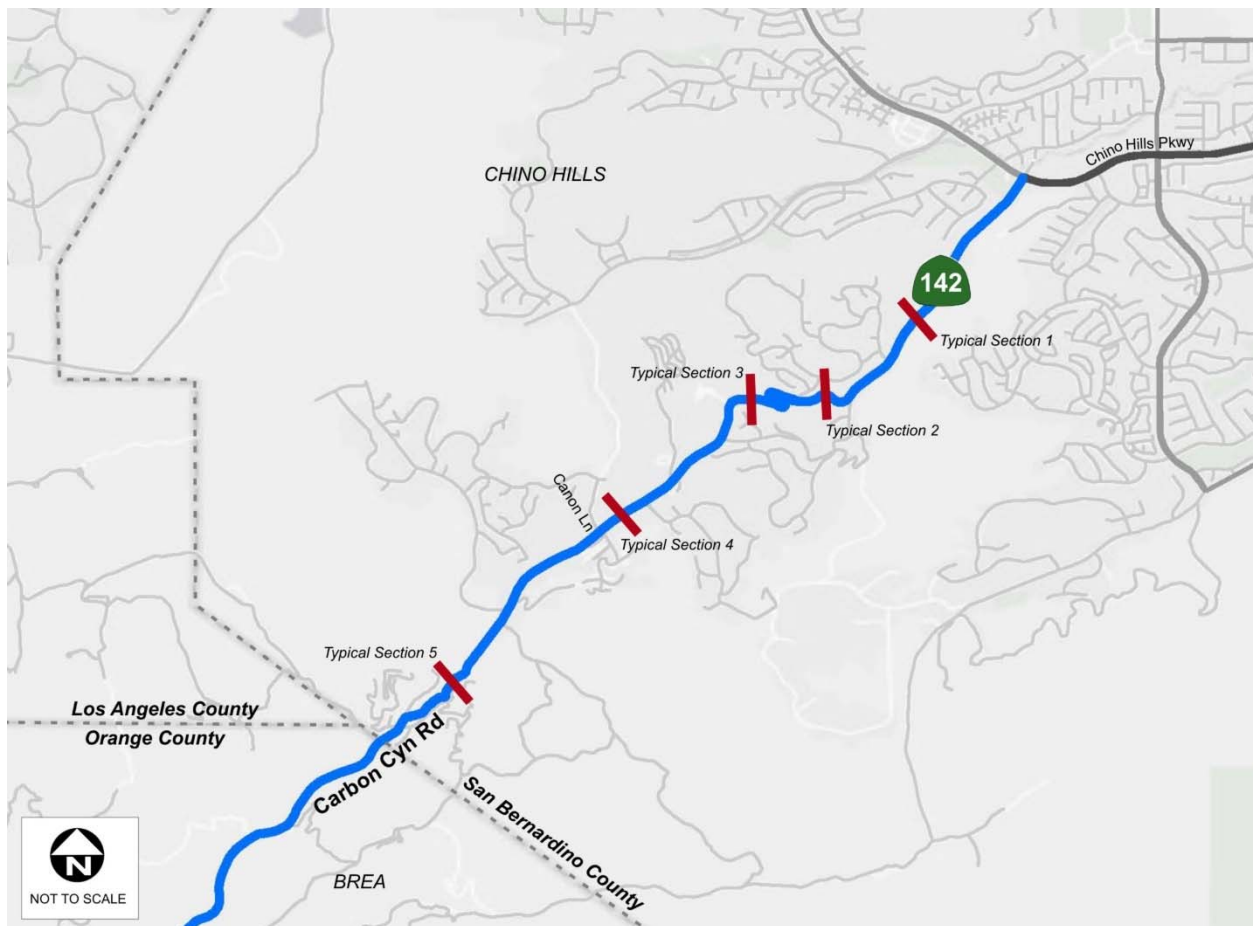




Figure 18 – Typical Section Locations



Typical Section 1 is located approximately 1,700 feet northeast of Feldspar Drive and consists of 100 feet of ROW width. At Typical Section 1, 30 feet of ROW is available, outside of the shoulders, on both the north and south sides of Carbon Canyon Road. As a result, no ROW would need to be acquired in order to construct a 5 foot bicycle lane and an 8 foot sidewalk (sidewalk could be 5 feet with a 3 foot buffer, for example).

Typical Section 2 is located approximately 600 feet east of Azurite Drive and consists of 60 feet of ROW width. At Typical Section 2, 15 feet of ROW is available on the south side and 18 feet of ROW is available on the north side of Carbon Canyon Road. There are no shoulders at this location. As a result, no ROW would need to be acquired in order to construct a 5 foot bicycle lane and an 8 foot sidewalk on both sides. However, significant cut/fill and utility relocations would be required.

Typical Section 3 is located approximately 1,300 feet northeast of Carriage Hills Lane, at the top of the S-curve area. The section consists of 60 feet of ROW width. At Typical Section 3, 20 feet of ROW is available on the north side, though there is a downhill slope after approximately 13 feet. On the south side, 13 feet of ROW is available, though there is an immediate uphill slope outside of the travel lane. As a result, no



ROW would need to be acquired in order to construct a 5 foot bicycle lane and an 8 foot sidewalk on both sides. However, similar to Section 2, significant cut/fill and utility relocations would be required.

Typical Section 4 is located approximately 550 feet northeast of Canon Lane and consists of 90 feet of ROW width. At Typical Section 4, 26 feet of ROW is available on the north side outside of the shoulder. On the south side, 23 feet of ROW is available outside of the travel lane, as there is no shoulder on this side. As a result, no ROW would need to be acquired in order to construct a 5 foot bicycle lane and an 8 foot sidewalk on both sides.

Typical Section 5 is located approximately 300 feet northeast of Rosemary Lane (east) in the Sleepy Hollow neighborhood, and consists of 40 feet of ROW width. There are no shoulders at this location and there are residences fronting the road in this area. In this section, 10 feet of ROW is available on the north side, though there is a downhill slope a few feet outside of the travel lane. On the south side, 8 feet of ROW is available, though there is an immediate uphill slope outside of the travel lane. As a result, no ROW would need to be acquired in order to construct a 5 foot bicycle lane, but approximately 3 to 5 feet of ROW would be needed in order to add a sidewalk on both sides. In addition, significant cut/fill would be required.

8.6 Additional Considerations

Based on community feedback, other potential improvements are considered as potential opportunities in this report. These other improvements are not geared towards congestion or speed reduction, but are considered important to quality of life, as expressed by members of the community. These improvements are:

- Pedestrian bridge over Carbon Canyon Road; and
- School bus stop treatments.

Residents within the Sleepy Hollow neighborhood, located at the southern edge of the City of Chino Hills, requested that the potential for constructing a pedestrian bridge be evaluated. A definitive location for the potential bridge was not identified. The roadway width and Caltrans ROW within this neighborhood is the smallest amongst the corridor, at approximately 40 feet. For this reason, as well as the lack of sidewalk on both sides of Carbon Canyon Road which would be required, construction of a pedestrian bridge is not considered a viable option at this time. In addition, there is no concentration of activity centers that would generate pedestrian traffic within this area.

Caltrans recently installed yellow school bus warning signs at a few locations along the corridor. To supplement these signs, it is recommended that flashing yellow lights be installed approaching the bus stop areas. The flashing lights would increase driver awareness of the presence of children. For safety purposes, at the current school bus stop locations along the corridor, Caltrans should consider constructing a paved waiting area for bus riders, as well as sidewalk, curb, and gutter. The dimensions of the waiting area would vary per location and would require further detailed study. **Figure 19** shows the current school bus pick-up/drop-off locations along the corridor within the City of Chino Hills. These include locations at Oak Way Lane, Rosemary Lane, Canyon Hills Road (Circle K), Canon Lane, and Valley Springs Road. There are no direct pick-up/drop-off



locations on Carbon Canyon Road within the City of Brea, as confirmed by the Brea Olinda Unified School District.



Figure 19 – Bus Stop Improvement Locations

8.7 Improvement Costs

As discussed, the improvements for consideration include safety enhancements and traffic calming measures. **Table 4** summarizes the comprehensive set of potential improvements within Chino Hills and Brea, and presents an order-of-magnitude cost estimate range for implementation of each improvement. These planning-level costs include construction, design, and right-of-way (if necessary).



Table 4 – Improvement Measures Cost Estimates

Improvement Measure	Cost Estimate Range
<i>Short-term Measures</i>	
New traffic signal at Canyon Hills Rd intersection (design in process)	\$300k - \$350k
New traffic signal at Azurite Dr intersection	\$300k - \$350k
New traffic signal at Canon Ln intersection	\$300k - \$350k
New traffic signal at Rosemary Ln intersection	\$300k - \$350k
Left-turn refuge/acceleration lane at Carriage Hills Ln intersection	\$10k - \$15k
Left-turn refuge/acceleration lane at Valley Springs Rd intersection	\$10k - \$15k
Channelizer “island” west of Old Carbon Cyn Rd	\$3k - \$5k
Channelizer “island” east of Carriage Hills Ln	\$5k - \$7k
Channelizer “island” east of Canon Ln	\$2k - \$3k
Channelizer “island” east of Discover Center Drwy	\$2k - \$3k
Speed feedback sign between Valley Springs Rd and Canon Ln	\$10k - \$15k
Speed feedback sign east of Olinda Dr (City of Brea)	\$10k - \$15k
Speed feedback sign east of Discovery Center Drwy (City of Brea)	\$10k - \$15k
Centerline or shoulder rumble strips near Discovery Center Drwy (City of Brea)	\$1k - \$2k
<i>Long-range Measures</i>	
Widening of SB Carbon Cyn Rd to 2 lanes for 0.5 miles from current 2-lane to 1-lane transition	\$750k - \$1.5 mil
Construction of NB free right-turn lane at Chino Hills Pkwy	\$1 mil - \$1.5 mil
Widening of WB Carbon Cyn Rd at Olinda Pl and Ruby St intersections (City of Brea)	\$3 mil - \$5 mil
Widening to add a 3 rd WB left-turn lane at Valencia Ave intersection (City of Brea)	\$1 mil - \$1.5 mil
Widening to extend NB free right-turn pocket at Valencia Ave intersection (City of Brea)	\$400k - \$500k
Widening/re-striping EB Carbon Cyn Rd to extend merge lane east of Valencia Ave intersection (City of Brea)	\$500k - \$750k
Construction of pedestrian sidewalk (one side) within Chino Hills – Approximately 3.8 miles	\$10 mil - \$15 mil
Construction of pedestrian sidewalk (two sides) within Chino Hills – Approximately 3.8 miles	\$25 mil - \$30 mil
Construction of bicycle lane (two sides) within Chino Hills – Approximately 3.8 miles	\$20 mil - \$25 mil
High Intensity Activated Crosswalk (HAWK) at Canon Ln intersection	\$100k - \$150k
Pedestrian bridge in Sleepy Hollow neighborhood	\$1 mil - \$1.5 mil
School bus stop location improvements – 5 locations	\$400k - \$500k



As shown in **Table 4**, improvements such as speed feedback signs and channelizer islands would be the simplest measures to implement due to the relatively low cost. Implementation of these measures would result in minimal, if any, disruption to traffic on the corridor.

As also shown, Iteris has evaluated the possible pedestrian and bike facility improvements along Carbon Canyon Road. As presented, the ultimate goal for enhanced pedestrian and bike mobility includes curbs, sidewalks, and dedicated bike lanes through the corridor. However, due to the current constraints, it would be impractical to implement any of these facilities without incurring significant expenses.

The majority of improvement measure costs would be attributed to the City of Chino Hills, particularly the long-range, high cost improvements. Costs attributed to the City of Brea mostly include low cost measures such as speed feedback signs, channelizers, and rumble strips. There are some high cost intersection-level improvements to be considered within the City of Brea, which require further feasibility evaluation.

9.0 NEXT STEPS

Upon completion of City review and approval, this report will be shared with Caltrans and the City of Brea. After that review process is complete, Iteris, in conjunction with the City of Chino Hills, will facilitate discussion with Caltrans on priority improvements in the corridor, including the recommended truck restriction. Funding for these improvements may be facilitated through Caltrans' State Highway Operation and Protection Program (SHOPP). The SHOPP is California's "fix-it-first" program that funds the repair and preservation, emergency repairs, safety improvements, and some highway operational improvements on the state highway system. SHOPP funds are limited to capital improvements that do not add capacity (no new highway lanes). The majority of transportation improvements identified in this report fall within the Transportation Management Systems (TMS) core asset class within the program. Other funding program options are Measure I or other State funding programs through the Regional Transportation Improvement Program, both administered through the San Bernardino County Transportation Authority (SBCTA).